Wheelabrator
SAUGUS

October 17, 2017

Mr. Mark Fairbrother
Solid Waste Section Chief, Northeast Regional Office
Massachusetts Department of Environmental Protection
205B Lowell Street
Wilmington, MA 01887

Re: Saugus Ash Monofill
Major Permit Modification (Transmittal No. X271439)
2017 Revisions to the Final Engineering Plan
Supplemental Information

Dear Mr. Fairbrother,

As a supplement to this application, we have prepared the attached memorandum on the performance of the environmental protection systems at the Monofill, which consist of a low-permeability barrier wall and a leachate collection system.

The containment systems at the Monofill have functioned well for more than two decades to protect the environment in accordance with all Department approvals.

Since they were first installed nearly 25 years ago, Wheelabrator has demonstrated persistent attention to the proper operation and maintenance of these important containment systems. Because of our past and continued focus, the system components will continue to protect the surrounding environment for decades to come.

Please let me know if you have any questions.

Sincerely,

James Connolly
Vice President
Environmental, Health and Safety

Attachments: October 17, 2017 Memorandum

Massachusetts Department of Environmental Protection

Supplemental Transmittal Form

(to accompany supplemental material or payment to previously submitted DEP permit applications)

1. Transmittal Number	Obtain from the upper right hand corner of the original application's Transmittal Form:	
	X271439	

2. Facility Information	(a) Facility Name:	(b) Facility Address:
	Saugus Ash Monofill	100 Salem Turnpike
	(c) Facility Town/City	(d) Telephone Number:
	Saugus, MA 01906	781-233-7600

3. Permit Information	(a) Permit Name:		(b) Permit Code: (from original application)	
	Landfill - Major Modification		BWP SW 11	

4. Reason For Supplemental Submission	☒	(a) Response to Request for Additional information	☐	(b) Response to Statement of Deficiency
	☐	(c) Supplemental Fee Payment	☐	(d) Withdrawal of Application
	☐	(e) Other (please specify below):		

5. Form Prepared by	(a) Name of individual or firm preparing this submission:	(b) Affiliation with application, i.e. applicant, consultant to applicant:
	Brown and Caldwell	Consultant to applicant
	(c) Contact Name:	(d) Contact Telephone #:
	Alan Kirschner, P.E.	508-819-1444

Wheelabrator
SAUGUS

MEMORANDUM

Date: October 17, 2017
To: James Connolly
From: Donald W. Musial, P.E.
Subject: Barrier Wall Performance

Summary

The purpose of this memorandum is to summarize the status of the barrier wall performance at the Saugus Ash Monofill. This memorandum also provides a description of the barrier wall origin, its components, and a summary of prior evaluations.

The Monofill's environmental containment system has been in operation for more than 20 years, with consistent submittal of monitoring data to the MassDEP and Saugus Board of Health on a routine basis as required by the MassDEP's solid waste permit.

Since first achieving the containment system's design conditions, the Monofill has met the established performance criterion at all times. Evaluations and ongoing monitoring required by the MassDEP's solid waste permit have shown the barrier wall and leachate collection system are performing to protect the environment in accordance with all associated regulatory approvals

Background

A 1989 Consent Order between the Massachusetts Department of Environmental Protection (MassDEP) and a Wheelabrator entity (Wheelabrator) required the construction of a containment system and a leachate collection system to enable the collection of leachate from the existing waste mass, and the creation of a contained ash monofill that would comply with modern landfill performance standards and regulatory policies. The Consent Order also required the design and implementation of environmental monitoring systems to monitor leachate and water quality.

The containment and collection systems consist of a vertical low-permeability subsurface barrier wall, or slurry wall, around the two-mile circumference of the Monofill to isolate the historic waste mass from the surrounding environment, and a high-permeability collection trench to the interior of the barrier wall with pipes leading to pump stations to collect and remove groundwater from within the waste mass. Together, these components formed the groundwater protection system for the Monofill.

These systems were installed in the early 1990's and they have been in continuous operation and the subject of ongoing monitoring and reporting since that time.

Regulatory Approvals

Consent Order

In 1987, the MassDEP issued a new policy for the disposal of ash generated by waste-to-energy facilities in Massachusetts: "Ash Management and Disposal Policy – SWM-7-8/88," dated May 13, 1987. This policy was later revised on August 3, 1988. The stated purpose of the policy was

to ensure that ash from energy from waste (EfW) plants being generated and disposed in Massachusetts was being managed in a manner that would protect the public health, safety, and the environment.

Prior to the issuance of this policy, the operations at the Monofill mainly consisted of spreading ash from the EfW plant as an intermediate cover over the historic MSW waste mass that had been placed prior to Wheelabrator becoming involved in the mid-1970's. When it took effect, the 1988 policy required ash to be disposed of in dedicated ash landfills, commonly referred to as monofills.

Within a monofill setting, ash could be isolated or segregated to prevent its contact with municipal solid waste or the leachate from that municipal solid waste. In addition, the policy required that any site accepting ash for disposal was required to incorporate best available engineering technology and have a groundwater protection and leachate control systems of a design approved by the MassDEP.

The 1988 policy required all new, upgraded, or expanded ash landfills to: 1) have a single composite liner, 2) provide for proper leachate collection, treatment, and disposal, 3) provide for an approved groundwater monitoring program, and 4) provide operational and design plans. The MassDEP policy allowed for alternative designs provided the design was demonstrated to offer a superior or equivalent level of protection to the MassDEP's satisfaction.

Under this new regulatory framework, Wheelabrator and the MassDEP ultimately entered into an administrative consent order in 1989 to create the path for establishing the site as an ash monofill for the continued management of ash from Wheelabrator's Saugus EfW plant. Section III.8.D of the Consent Order outlines the design requirements imposed by MassDEP for the barrier wall and the leachate collection system at the Monofill, consistent with MassDEP's 1988 Policy. Section III.8.D(1) states that the barrier wall, ash separation layer and internal leachate removal systems would be constructed as an alternative to a conventional liner and collection system. Section III.8.D(1)(a)(ii) further states that the barrier wall would be designed, installed and maintained to enable the efficient collection the migration of leachate from the landfill.

The design of the Monofill, based on the geologic setting and physical constraints of the site, adopted a barrier wall, ash separation layer and internal leachate removal system as an alternative to a traditional liner and collection system. Under MassDEP's 1988 Policy, this design incorporated best available engineering technology.

Final Engineering Plan

As stipulated by the 1989 Consent Order, Wheelabrator prepared and submitted a Final Engineering Plan (FEP) for the Monofill in 1990. The FEP contained engineering and design plans for the barrier wall and leachate collection and management systems, as well as, provisions for the routine operations of the facility and for its environmental monitoring.

The MassDEP issued a comprehensive approval of the FEP on August 9, 1991 which included an approval for the construction and operation of the barrier wall and leachate collection system (see Attachment A).

The FEP was first revised in 1993 to reflect changes to the engineering design desired prior to construction. The FEP was again revised in 1997 to account for the long-term operations of the Monofill.

The FEP was last revised in 2008 to reflect the reduction of the minimum final grades in the then-uncapped areas of the Monofill (i.e. Phases III, IV, and V).

System Components

The fundamental purpose of the barrier wall and leachate collection system was to establish a physical barrier to contain groundwater beneath the Monofill which had contacted waste (i.e. leachate). Together these components formed an alternative groundwater protection system for the Monofill that was approved by the MassDEP.

By using pumps to create an artificial inward hydraulic gradient, the system protects the environment by minimizing the migration of groundwater from the waste mass. The ideal condition is present when the groundwater elevation to the interior of the barrier wall is lower than the groundwater elevation to the exterior, thus creating inward gradient, or intergradient, condition.

The barrier wall itself consists of a manufactured low-permeability sodium-bentonite clay backfill that keys into the naturally-occurring clay layer underlying the entire site. The preferred method for this type of subsurface construction was slurry trenching. The resulting vertical barrier would have an installed permeability no faster than 1×10^{-7} cm/sec, which is the equivalent permeability required for a landfill baseliner system today.

In advance of the barrier wall's construction at the Monofill, its design engineer, Wehran EnviroTech, prepared a 1992 letter report for Wheelabrator on the expected long-term effectiveness of the barrier wall. This report concluded that this type of barrier wall would function as an effective barrier isolating the waste mass from the environment indefinitely (i.e. 100+ years). A copy of this July 10, 1992 letter is contained in Attachment B.

To control the groundwater elevation to the interior of the barrier wall, a relatively deep leachate collection trench with a perforated collection pipe was installed in the leachate collection trench along its entire length. The collection pipe was installed below sea level at an elevation of -3 feet Mean Sea Level.

Groundwater intercepted by the trench and collection pipe flows by gravity to one of three collection pump manholes spaced equally along the length of the pipe. The floor of each pump station is also below sea level at an elevation of -4 feet Mean Sea Level. The collected groundwater is then pumped to a wastewater pretreatment system at the plant. The pretreatment system was constructed in the early 1990's with the intent that the leachate from the Monofill would be reused at the Saugus EfW plant and displace the need for some of the municipal water already being consumed.

An average of approximately 50 million gallons of groundwater per year is currently removed from the 110 acres to the interior of the barrier wall.

The groundwater to the exterior of the barrier wall is not influenced by the leachate collection system monitored consistently and its elevation varies substantially around the site perimeter due to topography, off-site stormwater run-on, and ocean tidal influences.

Groundwater to the interior of the barrier wall is predominantly from one of three primary sources:

1) Groundwater that was present within the waste mass at the time the barrier wall was constructed;
2) Infiltration of contact stormwater and any free water present in the ash loads. This source accounts for more than 90 percent of the leachate pumped from the monofill; and
3) Upward flow from the bedrock aquifer due to normal head pressure effects.

By design, groundwater infiltration through the barrier wall itself is not considered a measureable source given the extremely low permeability of the wall materials. As an example of such a low permeability, if the water table on one side of the barrier wall remained 1 foot higher than the water table on the other side of the wall for a decade, engineering calculations estimate that the water would only move about 6 inches into a 5-foot thick wall.

Monitoring Requirements

Barrier Wall Piezometers

MassDEP has required ongoing monitoring of the performance of the barrier wall and leachate collection system. To implement this monitoring system, nine pairs of piezometers were installed at various locations along the barrier wall's length. Each piezometer pair, referred to as a "station", consists of one piezometer to the interior of the barrier wall and one piezometer to the exterior.

The elevation of groundwater at each piezometer is measured and recorded on a weekly basis. The weekly measurements are averaged every four weeks (28 days) to account for the lunar and tidal cycles that influence the readings.

When the piezometers were first installed, an automated data collection system was used to monitor the water level in each piezometer and record it electronically. The data collection system consisted of probes placed in each piezometer that monitored the water levels. The probes were hard-wired to the adjacent plant for electric power and for data transmission. The probes were cleaned and calibrated on a routine basis and replaced as needed.

As this system aged, the probes became less reliable due to electrical shorting, lightning strikes, and other uncontrollable issues. To assure the system was providing reliable water elevation data, in the early 2000's Wheelabrator began to supplement the electric readings with manual readings taken weekly. Starting in 2003, Wheelabrator began providing manual weekly readings in the third-party compliance inspection reports. The footnotes on the data tables submitted with these reports noted the manual collection of data. The electronic data collection system was eventually removed from service in 2005 and since that time Wheelabrator has collected manual water level readings.

The results of the piezometer monitoring are provided to the MassDEP and Saugus Board of Health in the continuing third-party landfill compliance inspection reports prepared for the Monofill. These reports are presently submitted to the regulatory agencies on a bi-monthly basis.

Internal Piezometers

To define the groundwater elevations within the interior of the landfill, several piezometers were installed in 1995 in the central regions of the site. To prevent confusion with the "interior" piezometers around the barrier wall, these centrally located piezometers are referred to as "internal" piezometers. In 2000, Wheelabrator installed seven additional internal piezometers to further assist in defining the groundwater elevations beneath the Monofill.

The groundwater elevation in the internal piezometers was measured annually during the 1990's and has been measured monthly since 2000. These results are provided to the MassDEP and the Saugus Board of Health annually as part of the Monofill's Annual Progress Report.

Reporting Requirements

Piezometer Water Elevations

Section 9.1 of the Operations and Maintenance Plan contained within the FEP requires Wheelabrator to compare the average water elevations in the interior piezometers to the average water elevations in the exterior piezometers to assess the performance of the barrier wall. This condition states that Wheelabrator shall "maintain the average monthly groundwater elevation within the slurry wall below the average monthly groundwater elevation outside the slurry wall."

This condition satisfies Section III.8.D(1)(c)(ii) of the 1989 Consent Order, which states that the leachate collection system shall "be capable of collecting and removing a sufficient volume of leachate to maintain a hydraulic head inside the perimeter of the completed barrier wall below the water table external to the barrier wall perimeter." This condition has been in-place since the issuance and approval of the original FEP in 1990.

As the system was being optimized during the 1990's, the average intergradient condition was intermittently achieved during the initial years of groundwater pumping until the summer of 2002 when these average intergradient conditions for the piezometer pairs were wholly met. Since securing this condition in 2002, Wheelabrator has continually met this performance standard whereby the average of the interior piezometers has been below the average of the exterior piezometers.

Figure 1 (attached) shows the tracking history for the average interior and exterior water levels since the first measurements were taken in 1994. Further detail on the system optimization is provided in the memorandum section on the leachate removal, treatment, and discharge.

As noted above, the results of the piezometer monitoring, including this comparison of the calculated values, are provided to the MassDEP and Saugus Board of Health bi-monthly in the third-party landfill compliance inspection reports prepared for the Monofill.

In September 2002, a MassDEP staff member who was newly-assigned to the Monofill wrote to Wheelabrator to inquire about the performance of the barrier wall after his review of the most-recent third-party compliance inspection report. This MassDEP staff member had been newly-assigned to the monofill due to the retirement of the previous staff member. The new staff member questioned whether the language contained in the third-party compliance inspection reports was explicit enough as to the performance of the barrier wall and leachate collection system with respect to the average water table on the inside of the barrier compared to the average water table on outside of the barrier

wall. Follow-up communications between Wheelabrator and the staff member resulted in a change to the language used in subsequent compliance inspection reports. To address the staff member's desire for clearer indication of performance, the language in following inspection reports was updated to specifically comment on the average intergradient conditions at the monofill (see Section 2.13 of inspection reports), comparing the average water level of all interior piezometers to the average water level of all external piezometers. The inspection reports have continued to use this same language to describe the barrier wall performance since 2002.

Preferential Collection of Leachate

Condition No. 6 of the MassDEP's 1991 approval requires Wheelabrator to notify the MassDEP if "preferential collection" of leachate from the landfill is the cause for any one of the piezometer pairs to fall outside of intergradient conditions for two months once that pair has achieved intergradient conditions.

The basis for this provision, written several years before the barrier wall was constructed, was to address the concern that the leachate collection pipe to the interior of the barrier wall and the distance between pump stations may result in groundwater not being removed or otherwise equally captured around the entire length of the barrier wall.

Once the leachate collection system was constructed and in operation the leachate collection pipe was found to have excellent connectivity around the entire perimeter. This continues to be demonstrated by the fact that the groundwater levels at all interior piezometers are very similar along the entire length of the barrier wall, with an average variation of roughly one foot around its nearly two-mile length. This is the equivalent of an extremely flat 0.0095% slope.

While measurements from isolated individual piezometer pairs have not been intergradient from time to time over the last 20 years of operations, the cause has never been found to be the preferential collection of leachate within the landfill as evidenced by the excellent connectivity of the leachate collection pipe around the entire perimeter of the site and the similar water levels at all interior piezometers. As such, it has never been necessary for Wheelabrator to provide a notice under this condition.

Barrier Wall Performance

When the barrier wall construction was substantially completed at the end of 1993 and pumping began in 1994, none of the piezometer pairs were at intergradient conditions and there was a 12-foot mounding of groundwater to interior of the site indicating that it would take several years to achieve intergradient conditions. A letter report from Wheelabrator to the MassDEP dated November 29, 1994 provides a summary of the initial observations and trends from that period. This letter was submitted to fulfill the requirements of Condition 5 of the MassDEP's 1991 approval of the barrier wall. A copy of this letter is included as Attachment C.

Through a combination of consistent groundwater removal rates and the construction of over 45 acres of final cover in 1994 and an additional 41 acres of final cover in 1995, the interior groundwater elevations steadily decreased so that by 1996, intergradient conditions were regularly met at four to five of the nine piezometer pairs.

From 1996 to 2000, relatively steady-state groundwater pumping and mounding conditions were maintained at the monofill.

Following the installation of an additional 16-acres of final cover in 1999, Wheelabrator engaged a consulting firm, EMCON, in 2000 to conduct a comprehensive review of the barrier wall performance. The primary purpose of this work was to assess for potential conditions that could be contributing to the groundwater to the interior of the barrier wall and to identify strategies for maintaining intergradient conditions.

Following the recommendations from EMCON's evaluation, Wheelabrator made a number of changes to the leachate pretreatment system over the period of a couple of years that increased groundwater pumping rates. These changes are discussed in a later section of this memorandum.

The increased pumping rate caused the water levels at the interior piezometers to drop markedly lower so that by the summer of 2002, all nine piezometer stations averaged to consistent and sustainable intergradient conditions. Since this condition was achieved in 2002, the average intergradient condition has never reversed.

These continued efforts in pumping and runoff management led to Wheelabrator first achieving sustained intergradient conditions at all nine piezometer pairs in November 2003. Figure 2 shows the progression of achieving an intergradient condition at each of the nine piezometer pairs starting with the first readings in 1994.

Barrier Wall Evaluations

EMCON's evaluation in 2000 reviewed the leachate generation analysis, recommended the installation of additional internal piezometers, evaluated the integrity of the lined stormwater sedimentation basin, collected in-place samples of the barrier wall materials, inspected for areas of potential stormwater ponding, and collected groundwater samples from the piezometer pairs for laboratory analysis.

1. *Barrier Wall Materials*

   In August 2000, core samples were taken from the barrier wall to determine its in-place properties. These samples were taken at three different depths from three locations spaced evenly around the perimeter of the barrier wall. Each sample was tested at a laboratory for gradation, permeability, pliability, and plasticity.

   The in-place permeability of the slurry wall ranged from 1.55×10^{-7} cm/sec to 4.0×10^{-8} cm/sec, with an overall average permeability of 6.8×10^{-8} cm/sec. These results showed that the general permeability of the barrier wall was consistent with the permeability when it was installed several years earlier.

   The report concluded that the laboratory testing of the collected samples demonstrated that the in-place barrier wall materials were consistent with its original properties.

2. *Stormwater Sedimentation Basin*

In September 2000, a non-intrusive assessment of the stormwater sedimentation basin was conducted to confirm that the geomembrane layer underlying the basin was functioning properly and that stormwater runoff within the basin was not contributing to the groundwater volume to the interior of the barrier wall. To assess the geomembrane integrity, a hydrostatic test was conducted over a two week period.

The basin's outlets were blocked with polyethylene covers to allow runoff to build-up within the basin. Markers were placed within the basin to allow the water depth to be monitored and recorded. Over a two-week period of no rainfall, daily measurements of the water level showed no changes.

During the same period, the water level at the interior piezometers surrounding the basin was also monitored to determine if there were any changes to the groundwater elevations in the area of the basin. An increase in the groundwater elevations would have suggested that additional water infiltrating from the sedimentation basin was mounding. However, this monitoring found no changes to the water levels throughout the evaluation period.

The hydrostatic testing and groundwater elevations in the area of the sedimentation pond established that the geomembrane below the sedimentation basin was adequately preventing stormwater from infiltrating into the waste mass. This demonstrated that the geomembrane underlying the sedimentation basin was not leaking and was functioning as designed.

3. *Water Quality Sampling*

In September 2000, water samples were collected from several interior and exterior piezometers for laboratory water quality analysis. The purpose of this sampling was to determine if there were any noteworthy trends between the interior and exterior piezometers that could indicate a correlation across the barrier wall.

Following this initial evaluation, water quality samples from several piezometers continued to be collected quarterly for laboratory analysis to confirm the initial data. The confirmatory data from these additional samples did not show new or conflicting data.

This evaluation established that there was not a correlation between the interior and exterior piezometers to indicate an issue with the barrier wall.

4. *Internal Piezometers*

The water elevations of the internal piezometers are primarily used to estimate the total volume of leachate present within the Monofill. A secondary purpose of the internal piezometers is to assess for mounding of groundwater within the 110-acre area contained by the barrier wall.

Figure 3 shows a comparison of the average water elevations of the interior piezometers along the barrier wall to the two internal piezometers located in the central areas of the site. As shown on this figure, the water elevation of the mound has been lowered by approximately 5 feet since the early 2000's.

In general, there is presently only a 2-foot difference in height from the interior piezometers to the height of the mound over a nearly 2/3 mile distance. This equates to a nearly flat slope of roughly 0.06% for the water table to the interior of the barrier wall. This very flat surface indicates that groundwater to the interior of the barrier wall is quickly flowing into the perimeter leachate collection system as designed.

Leachate Removal, Treatment, & Discharge

Initial Years (1992 to 2000)

The discharge of leachate from the Monofill to the municipal sewer system is primarily regulated by a permit issued by the City of Lynn Water & Sewer Commission. There has been a discharge permit in place for the Monofill since the early 1990's. The Monofill also holds an industrial sewer user permit issued by the MassDEP.

The original pretreatment system installed in 1992 was designed to treat leachate at a peak flowrate of 175 gallons per minute (gpm). Based on this design, the initial permit issued by the Lynn Water & Sewer Commission limited Wheelabrator's discharge to a monthly average of 200,000 gpd (approx. 140 gpm) and a daily maximum of 300,000 gpd (approx. 210 gpm).

During the first few months of its operation the actual flowrate through the pretreatment system was found to be markedly less due to the high concentration of iron in the leachate that was found to be oxidizing and plating out in the system's piping, tanks, and instruments.

At that time, several system modifications were completed to remove this iron and improve the overall treatability of the system. These modifications first resulted in a maximum flowrate of approximately 125 gpm, but this gradually reduced to only 100 gpm within a short period of time. Leachate removal from the monofill continued around this level throughout the 1990's.

Middle Years (2000 to 2012)

One of the key takeaways from EMCON's evaluation in 2000 was to increase the leachate removal rate to accelerate the achievement of consistent intergradient conditions at the piezometer stations.

Following up on these recommendations, Wheelabrator identified and instituted changes to its operation of the leachate treatment system to increase flowrates. These changes included the use of new flocculants and the changing other chemicals for cleanings. The changes also resulted in the need to perform very frequent backwashes of the system. These changes resulted in an increased peak flowrate of more than 150 gpm by 2002, with an average flowrate of roughly 125 gpm.

At that time, Wheelabrator also began working with several manufacturers and consulting firms to replace the entire pretreatment system. In 2004, Wheelabrator engaged Shaw Environmental to design and procure a new pretreatment system. This work evolved into an attempt to design and construct a larger and more robust treatment system that could render the Monofill's leachate to such a high quality that it could replace the municipal water being utilized in all plant processes. Further study revealed this approach was not feasible at that time so Wheelabrator revisited making simpler modifications to the existing pretreatment system.

In September 2005, the Lynn Water & Sewer Commission approved Wheelabrator's request to amend its permit to increase the monthly average to 250,000 gpd. The Lynn Water & Sewer Commission also approved Wheelabrator's request to discharge untreated leachate directly to the sewer system at that time. This approval was granted because the untreated leachate was found to already meet the water quality standards for a direct discharge to the sewer system. The leachate discharged from the Monofill is regularly sampled for water quality and continues to meet the limits of the discharge permit.

These systematic and operational changes to the leachate management system allowed flowrates to increase to more than 150 gpm by the end of 2006.

While the concentration of iron in the Monofill's untreated wastewater was within the limits of the Lynn Water & Sewer permit, it was found to be an issue in practice due to the amount of iron-oxide precipitation that was being deposited in the downgradient municipal sewer system. In 2007 and 2008, the discharge of untreated leachate to the sewer resulted in frequent cleanings (i.e. quarterly) of the forcemain pipe due to this iron precipitation.

To resolve these ongoing operational issues, Wheelabrator replaced the original clarifier unit in 2008 with a new flocculation system, commonly referred to as the Lamella system. This new component required much fewer cleaning cycles and therefore allowed the leachate system to operate more continuously.

From 2008 to 2012, relatively steady-stage pumping rates were maintained. During this time, the system was consistently removing roughly 4.5 to over 5 million gallons of leachate per month.

Recent Performance (2012 to Present)

Starting in 2012, the leachate pumping rates were decreased in an attempt to balance the groundwater removal rates necessary to maintain the average intergradient conditions. Pumping rates for this period were reduced to roughly 3 to 3.5 million gallons per month.

By early 2016 it was apparent that higher pumping rates were needed to account for higher groundwater elevations associated with seasonal precipitation and cyclic weather fluctuations. The leachate pumping rates were increased to the prior levels of 4.5 to 5 million gallons per month, which drove the interior groundwater levels down to their current levels.

The pumping trends for this period are shown on Figure 3. During certain outages at the EfW plant, the leachate pumping rates will be slowed since the pretreated wastewater is unable to be used within the EfW plant. There are also times of reduced flow due to normal maintenance of the leachate pretreatment system. At this time, all leachate generated at the Monofill is pumped to the pretreatment system and reused within the EfW plant.

The Monofill pumps a long-term average of 800 to 900 gallons of leachate per day per acre of uncapped area per inch of precipitation (gpad/inch). This leachate generation rate is consistent with what would be predicted for a modern monofill in this region.

Conclusions

In summary, the environmental containment system at the Monofill, which consist of a low-permeability barrier wall and a leachate collection system, are functioning as intended to protect the environment. For more than 20 years since the system's installation, Wheelabrator has followed the approved groundwater monitoring program and submitted required data to the MassDEP and Saugus Board of Health.

The historic data from the groundwater monitoring program shows a steady progression throughout the 1990's towards achieving the containment system's design conditions in the early 2000's. Since that time, the Monofill has met the performance criterion established by the 1989 Consent Order between Wheelabrator and the MassDEP and the MassDEP solid waste permit and all associated regulatory approvals.

Figures

1 Water Elevation of All Piezometer Stations
2 Piezometer Stations at Intergradient Conditions
3 Water Elevation at Interior Piezometers vs. Internal Piezometers
4 Water Elevation at Interior Piezometers vs. Leachate Pumping Volume

Attachments

A August 9, 1991 approval from MassDEP to RESCO
B July 10, 1992 letter from Wehran EnviroTech to RESCO
C November 29, 1994 letter from RESCO to MassDEP

Figure 1
Average Water Elevation of All Piezometer Stations
(based on 28-day Averages)

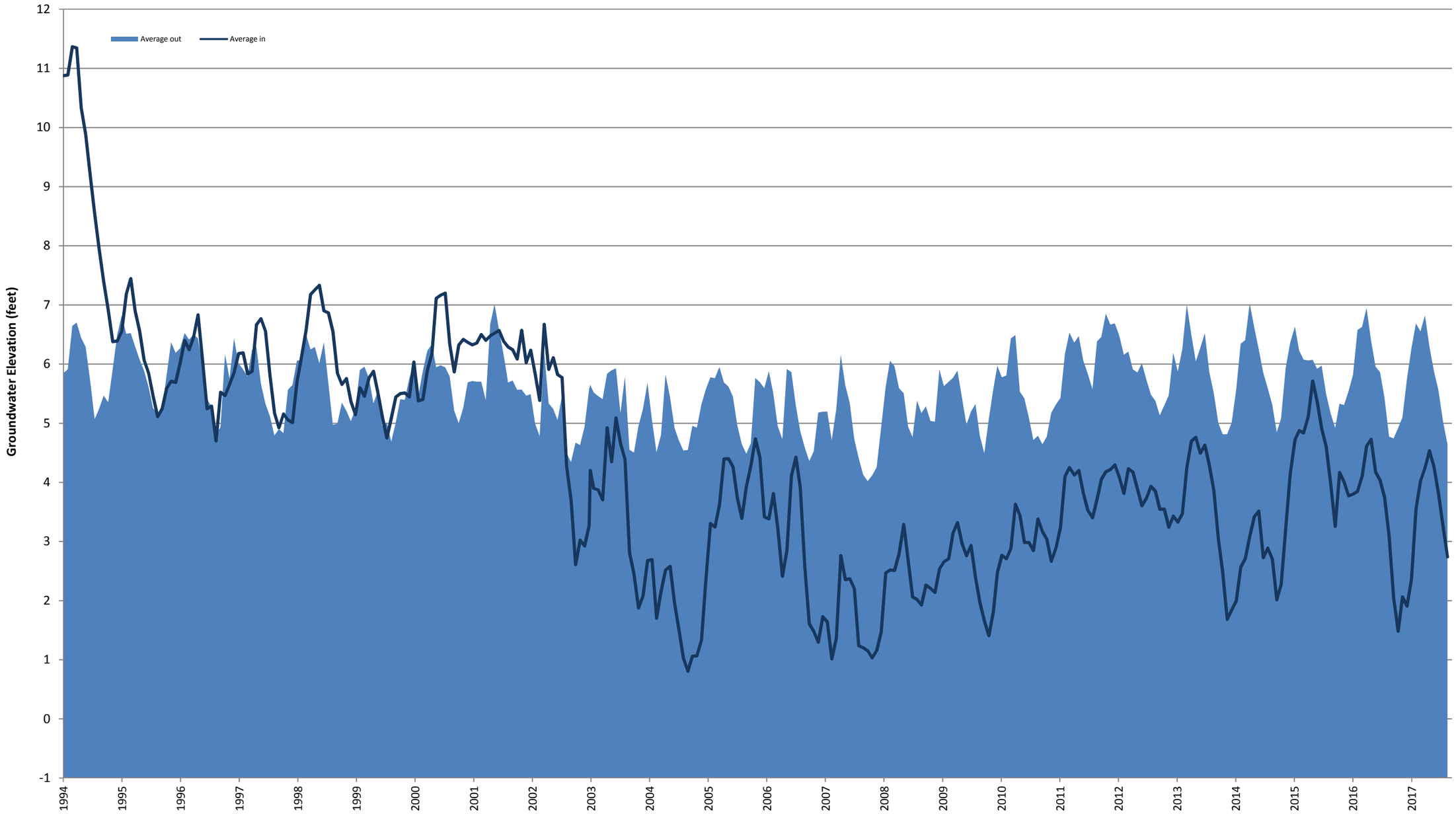


Figure 2
Piezometer Stations at Intergradient Conditions
(based on 28-day Averages)

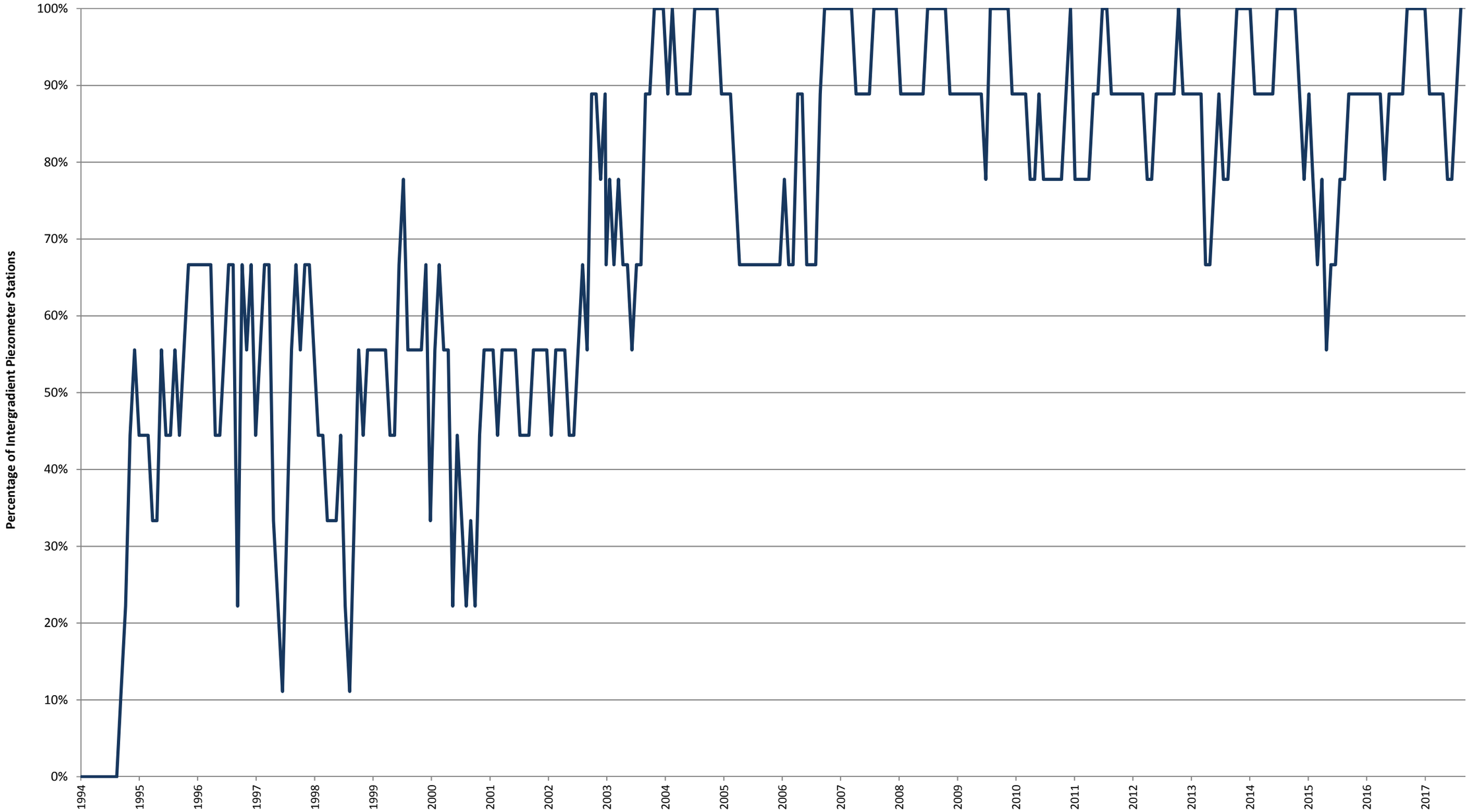


Figure 3
Average Interior Water Elevation vs. Leachate Pumping Volume
(based on 28-day Averages)

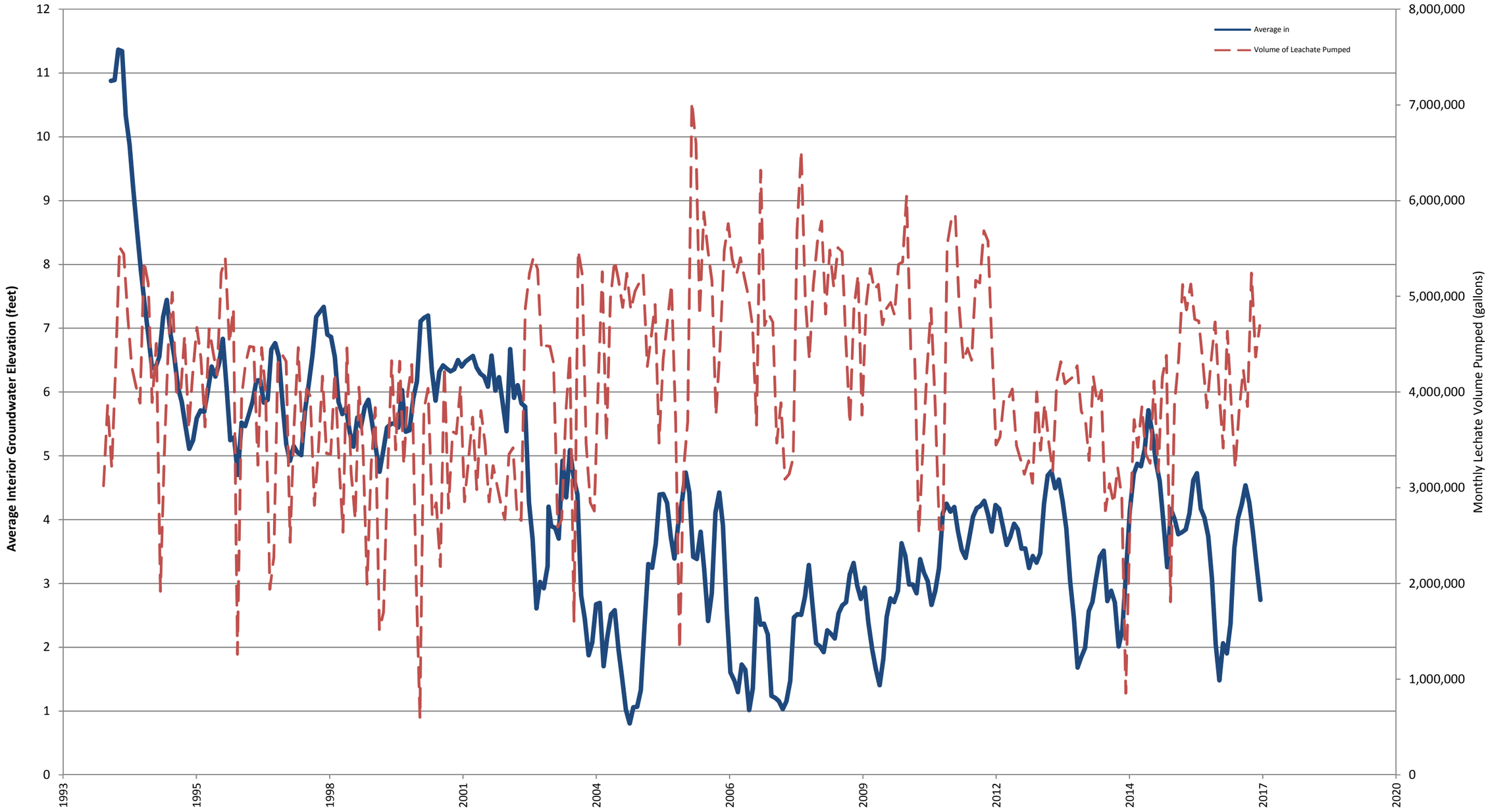
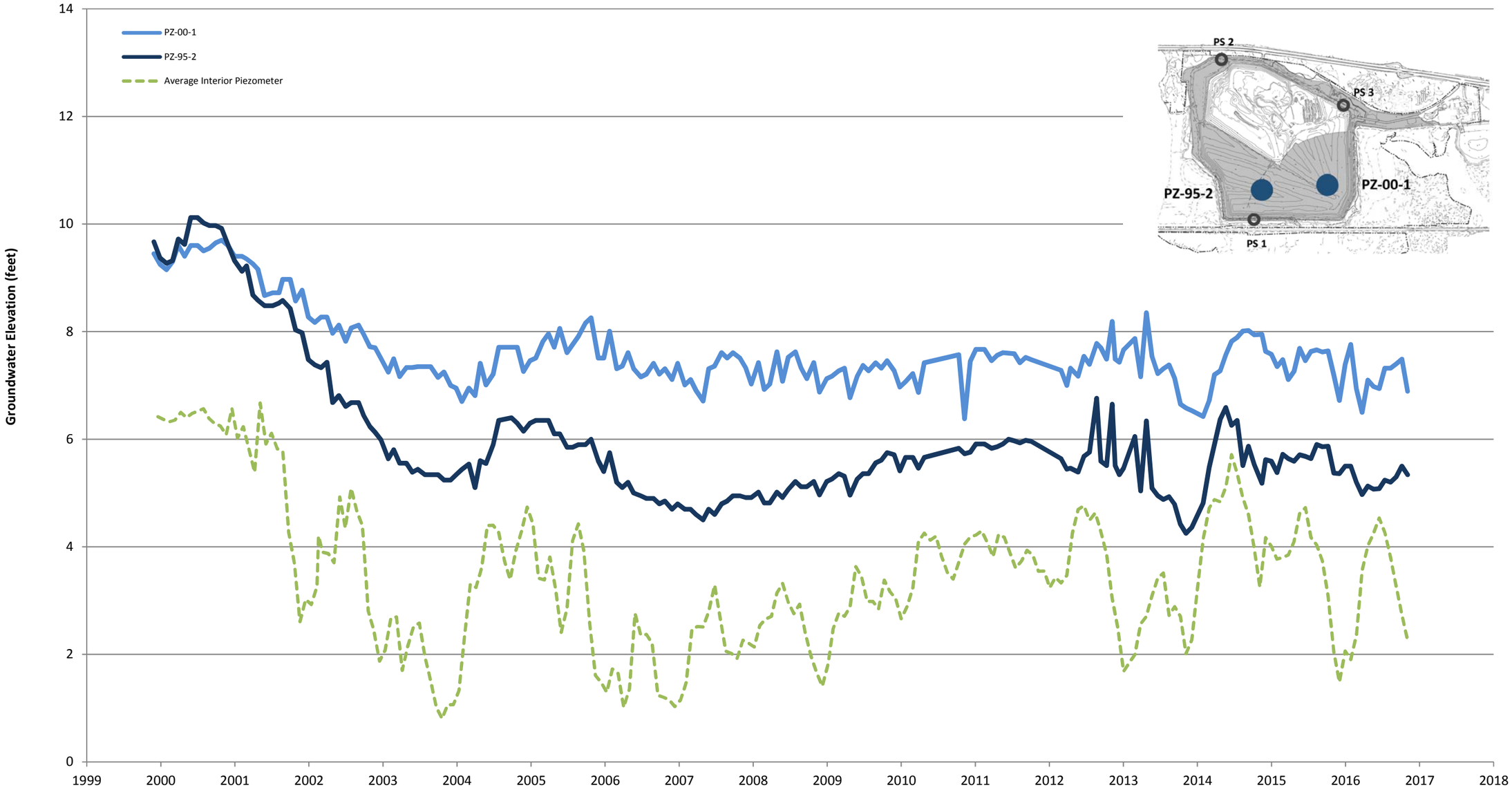


Figure 4
Internal Piezometers vs. Average Interior Piezometers



ATTACHMENT A

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

Daniel S. Greenbaum
Commissioner

DATE: August 9, 1991

HAND DELIVERED 8/9/91

RESCO
100 Saugus Turnpike
Saugus, MA 01906

Re: SAUGUS/Solid Waste
RESCO/Ash Landfill
Approval Final Engineering Plan/Existing Landfill Permit/ Authorization to Construct/ Authorization to Operate
NESW-89-059

Attention: Mr. Bruce Manning
Plant Manager

Mr. Manning:

The Metropolitan Boston-Northeast Region Office of the Department of Environmental Protection (the "Department") is in receipt of engineering plans and reports (the "FEP") prepared for the design, construction, operation, maintenance and closure/post-closure design of the Landfill. Capitalized terms used herein, unless otherwise defined herein, shall have the same meaning as ascribed to such terms in a consent order issued by the Department and consented to by Refuse Energy Systems Company ("RESCO"), dated June 29, 1989, as amended June 11, 1990 (the "Consent Order").

The engineering design plans are entitled:

"Engineering Design Plans for the Saugus Landfill Project"; Town of Saugus, Essex County, Massachusetts ("Engineering Design Plans")

Prepared for Refuse Energy Systems Company
Dated: December, 1989; Revised November, 1990
Sheets 1 through 13 and Sheets 18 and 19
Revised May 14, 1991
Sheets 14 through 17 and Sheet 20

The reports are entitled:

"Final Engineering Plan for the Saugus Landfill (Volume I)"
Dated: December, 1989; Revised November, 1990, May 13, 1991, and July, 1991
"Final Engineering Plan for the Saugus Landfill (Volume II)"
Dated: December, 1989; Revised November, 1990

The engineering plans and reports were prepared and stamped by:

Patrick G. Gillespie, Mass. P.E. #32697
WehranEnvirotech
Wehran Engineering Corporation
Andover, Massachusetts
Dated: December 5, 1990

The FEP was submitted on December 10, 1990, for approval pursuant to the Consent Order and as a request to modify a permit under 310 CMR 19.039. Additionally, RESCO requests authorization to construct under 310 CMR 19.041 and authorization to operate under 310 CMR 19.042.

In reviewing the applicant's request to modify a permit, the Department considered the requirements of the Consent Order and the criteria set forth at 310 CMR 19.038(2)(a)1-10, (c) and (d), as required by 310 CMR 19.038(1)(e). For the reasons set forth below the Department finds that RESCO has met all of the criteria for a permit modification.

1. RESCO received certification of compliance with MEPA from the Secretary of Environmental Affairs on February 12, 1990 (Certificate # 8090).

2. The Landfill is located within the boundaries of a valid site assignment pursuant to M.G.L. c. 111, s. 150A.

3. The engineering plans and reports provide for the design, construction, operation, maintenance, closure and post-closure maintenance of the Landfill and its environmental monitoring systems in compliance with 310 CMR 19.000 and the Department's policies applicable to ash landfills, including SWM-7-8/88 (Ash Management and Disposal Policy) and SWM-9-8/88 (Ash Sampling and Analysis Guidance).

4. The design, construction, operation and maintenance of the Landfill will not constitute a threat to public health, safety or the environment.

5. The Landfill design and operation includes components and measures which will ensure compliance with other applicable state and federal laws, regulations and policies.

6. The Landfill is not subject to the waste bans established under 310 CMR 19.017 because it receives only ash generated by a solid waste combustion facility.

7. RESCO is in compliance with all applicable statutes, regulations and administrative orders.

8. The construction, operation and maintenance of the Landfill does not represent a bird hazard.

9. The ground support for the structural components of the Landfill is adequate.

10. The construction, operation and maintenance of the Landfill will not cause or contribute to the taking of any endangered or threatened species of plants, fish or wildlife.

11. The Landfill is not located:

a. in the Zone II area of an existing or potential public water supply well;

b. within 15,000 feet upgradient of an existing public water supply well;

c. in the Interim Wellhead Protection Area of an existing or potential public water supply well; or

d. within the recharge area of a sole source aquifer.

12. The Landfill is not located on a site which the Department has determined infeasible to adequately conduct appropriate environmental monitoring.

13. The Landfill does not represent a threat to public health, safety or the environment due to concentration or migration of explosive gases, excluding gas control or recovery system components, at the Landfill or beyond the Landfill property boundary.

14. The leachate containment structure of the Landfill will not be located within a resource area protected by the Wetlands Protection Act, M.G.L. c.131, s.40, including the 100 year floodplain.

15. There will be no lateral expansion of the waste deposition area of the Landfill within the following distances:

a. 100 feet of the nearest edge of the property boundary;

b. 500 feet of a private water supply well;

c. 500 feet of an occupied residential dwelling, bedded health care facility, prison or lower educational institution or children's pre-school, excluding equipment storage or maintenance structures;

d. a resource area protected by the Wetlands Protection Act, M.G.L. c. 131, s. 40, and the regulations promulgated thereunder at 310 CMR 10.00, including the 100 year floodplain;

e. 2500 feet upgradient or 500 feet downgradient of a surface drinking water supply;

f. 250 feet upgradient of a perennial watercourse that drains to a surface drinking water supply where the Landfill is within one mile of the surface water supply; or

g. 250 feet of a lake, pond or navigable river other than a drinking water supply.

16. The Landfill is not subject to the recycling criteria in 310 CMR 19.038(2)(d) because it receives only ash generated by a solid waste combustion facility.

The Department, therefore, hereby approves the FEP and grants to RESCO an Existing Facility Permit under 310 CMR 19.037 subject to the following conditions which the Department deems necessary to protect the public health, safety or the environment:

1. RESCO shall comply at all times with the terms and conditions of this permit and approval, 310 CMR 19.000, M.G.L. c. 111, s. 150A, and all other applicable state and federal statutes and regulations.

2. RESCO shall obtain Department approval prior to selecting a final cover design other than the preferred geomembrane option depicted on Sheet 19 of 20 "Final Cover Detail." Any such request for approval shall include all applicable seaming or joining, installation, and Quality Assurance/Quality Control methodologies.

3. RESCO shall submit to the Department for approval the design, technical specifications and operational and maintenance plans for the proposed leachate treatment system within sixty (60) days of issuance of this permit.

4. Six (6) inches of uniformly compacted intermediate cover material approved by the Department shall be applied on the top and side slopes of all areas of the Landfill on which ash has been deposited which have not received or will not receive additional ash for thirty (30) days. Areas targeted for final closure by December 31, 1991, shall not be required to receive intermediate cover.

5. In the event the Leachate Collection System fails to achieve an intergradient condition within six (6) months of the date of completion of the slurry wall or the expiration of the slurry wall installation period, as defined in paragraph 8.D.(1)(a)(iv) of the Consent Order, whichever is shorter, RESCO shall submit to the Department for approval, within thirty (30) days of such failure, a plan and implementation schedule for achieving an intergradient condition.

6. In the event the Leachate Collection System results in the preferential collection of leachate from the landfill causing or contributing to the failure of any of the piezometer couplets to meet performance standards, as established in the Consent Order, RESCO shall submit to the Department for approval within thirty (30) days of such failure, a plan and implementation schedule addressing the deficiency and proposing recommendations to resolve the deficiency. For the purpose of this condition, the Department will deem the failure of any one, or combination of, piezometer couplets to indicate an inward hydraulic gradient across the slurry wall for two (2) consecutive months after an inward gradient condition has been achieved to be a failure of the Leachate Collection System to meet its performance standard.

7. RESCO shall report to the Department all deviations from the FEP in the monthly and semi-annual inspection reports required by the Consent Order which occurred during the respective reporting period.

8. RESCO shall make no changes and/or alterations to the FEP without prior written approval by the Department.

AUTHORIZATION TO CONSTRUCT

The Department hereby issues to RESCO authorization under 310 CMR 19.041 to construct all engineering features of the Landfill in accordance with the FEP which are not located in areas subject to protection under the Wetlands Protection Act. The Department's authorization to construct those engineering features located in areas subject to protection under the Wetlands Protection Act will be effective when RESCO provides proof of receipt of all applicable local, state and federal permits, approvals and authorizations required for the construction of the Landfill.

AUTHORIZATION TO OPERATE

The Department hereby issues to RESCO authorization under 310 CMR 19.042 to operate the Landfill in accordance with the FEP subject to RESCO providing appropriate financial assurance in accordance with 310 CMR 19.051 and paragraph 16 of the Consent Order.

NOTICE OF RIGHT TO APPEAL

RESCO is hereby notified that it may within twenty-one (21) days file a request that this decision be deemed a provisional decision under 310 CMR 19.037(4)(a), by submitting a written statement of the basis on which RESCO believes it is aggrieved, together with any supporting materials. Upon timely filing of such a request, the decision shall be deemed a provisional decision with an effective date twenty-one (21) days after the Department's receipt of the request. Such a request shall reopen the administrative record, and the Department may rescind, supplement, modify, or reaffirm its decision. Failure by RESCO to exercise the right provided in this section shall constitute a waiver of RESCO's right to appeal.

Appeal. Any person aggrieved by the issuance or denial of this permit, except as provided for under 310 CMR 19.037(4)(b), may file an appeal for judicial review of said decision in accordance with the provisions of M.G.L. c. 111, s. 150A, and

M.G.L. c. 30A, not later than thirty (30) days following the receipt of the final permit. The standing of a person to file an appeal and the procedures for filing such appeal shall be governed by the provisions of M.G.L. c. 30A. Unless the person requesting an appeal requests and is granted a stay of the terms and conditions of the permit by a court of competent jurisdiction, the permit decision shall remain effective or become effective at the conclusion of the thirty (30) day period.

Notice of Action. Any aggrieved person intending to appeal a grant or denial of a permit to the Superior Court shall first provide notice to the Department of his or her intention to commence such action. Said notice of intention shall include the Department file number and identify with particularity the issues and reason why it is believed the permit decision was not proper. Such notice shall be provided to the Office of General Counsel of the Department and the Regional Director for the regional office which processed the permit application. The appropriate addresses to send such notices are:

General Counsel
Department of Environmental Protection
One Winter Street - 3rd Floor
Boston, MA 02108

Regional Director
Department of Environmental Protection
5 Commonwealth Avenue
Woburn, MA 01801

No allegation shall be made in any judicial appeal of a permit decision unless the matter complained of was raised at the appropriate point in the administrative review procedures established in 310 CMR 19.000; provided, however, that a matter may be raised upon a showing that it is material and that it was not reasonably possible with due diligence to have been raised during such procedures or that matter sought to be raised is of critical importance to the environmental impact of the permitted activity.

If you have any questions please contact Mr. Luke Fabbri at Department of Environmental Protection, Division of Solid Waste Management, 4th Floor, One Winter St., Boston, MA 02108, or phone (617) 556-1061; or Mr. David Adams of my staff at the letterhead address or phone (617) 935-2160.

Very truly yours,

E. H. MacDonald

Edward H. MacDonald
Regional Engineer for
Waste Prevention

cc: DEP/DSWM - Boston, attn: Willa Kuh, Director
DEP/DSWM - Boston, attn: Luke Fabbri
Saugus Board of Health
Wheelabrator Environmental Systems Inc., New England
Regional Office, Liberty Lane, Hampton, NH 03842
attn: Robert Jacques
Committee of Natural Resources, attn: Representative Steven
Angelo

EHM/laf/permit.app

ATTACHMENT B

5.2.6.1.2

WehranEnviroTech

Wehran Engineering Corporation
Andover Research Park
Six Riverside Drive, Suite 101
Andover, Massachusetts 01810-1121
Tel: 508-682-1980
Fax: 508-975-2065

July 10, 1992

Mr. Robert P. Jacques
Manager of Landfill Operations
Wheelabrator Technologies, Inc.
Liberty Lane
Hampton, NH 03842

RE: Environmental Slurry Wall
RESCO Saugus Landfill
Wehran Project No. 09434.EM

Dear Mr. Jacques:

This letter is in response to your recent inquiry regarding the potential long term effectiveness of the environmental slurry wall which has been designed for the Saugus Residue Landfill Facility. Please be assured that the proposed slurry wall, if constructed and maintained as specified, should function as an effective hydraulic barrier isolating the landfill from its external environment indefinitely, i.e. 100+ years unless subjected to extreme and unanticipated physical damage.

Because the RESCO Saugus Landfill is located in a protected salt marsh and the combined desire of the Massachusetts Department of Environmental Protection (DEP), Wheelabrator Technologies, Inc. and Saugus RESCO is to design and construct an environmentally sound containment system, many environmental and engineering studies were conducted by Wehran Engineering to determine the best solution to isolate the landfill from its surrounding environment. These studies culminated in the Final Engineering Plans (FEP), approved by DEP, which selected and engineered a slurry wall solution.

The essence of the slurry wall solution for the RESCO Saugus Landfill is the perimeter encapsulation of the site by a low permeability vertical slurry wall that extends from the surface of the site (keyed) into the low permeability Boston Blue Clay layer underlying the site. This hydraulic barrier will effectively cut-off the migration of groundwater from the site to the surrounding areas. By installing this engineered barrier the site will be turned into a "bath tub". Any liquid currently within the site will remain within the site and any liquid (precipitation) that falls on the site and percolates into the landfill will be collected in the "bath tub." Two systems ancillary to the slurry wall are also considered part of the slurry wall system. A leachate collection, pumping and treatment system to maintain the liquid level in and avoid overflowing of the "bath tub" and a soil/geomembrane cap to reduce the amount of liquid that will percolate into the site (ie: into the "bath tub") in the future. As an added assurance to the environmental soundness of the slurry wall system, the liquid level within the site will be maintained lower than the surrounding liquid level in the salt marshes. In the

hypothetical event that a portion of the slurry wall was "removed" from around the site, this inward differential of liquid levels would allow the salt marsh to flow into the site and prohibit the liquid in the site from flowing into the salt marsh.

Although this particular slurry wall solution is engineered specifically for the RESCO Saugus Landfill, it is an application of the proven technology for the design and construction of these barriers. Slurry walls were first engineered and constructed in Italy in the late 1930's, then called continuous diaphragm walls, as a development from the use of slurries and muds in oil well drilling operations. Slurry walls were first used in the United States by the U.S. Army Corps of Engineers in the late 1940's. One of the first documented uses by the Corps was at Terminal Island in California to control salt water intrusion into the fresh water zone; an application not so different than the slurry wall solution for the RESCO Saugus Landfill.

From the 1940's to the 1980's slurry wall technology developed in both the United States and Europe. Since the 1980's, the emergent leading professional authority on slurry wall technology has been the American Society for Testing and Materials (ASTM) Committee D18 on Soil and Rock. (Note that Mr. Cavalli is Chairperson of their subcommittee on slurry walls) Current slurry wall applications include retaining structures, load-bearing elements, underground facilities, waterfront installations, cut-offs beneath dams, repair of dams and pollution migration control barriers. Today there are hundreds of environmental slurry walls constructed throughout the world including a large number at Federal Superfund hazardous waste sites. Slurry walls are universally accepted by engineers and regulatory agencies as a long-term remedial measure for the environmental control of pollution migration from hazardous and solid waste sites.

In 1987 Wehran developed and submitted to our client, the Northeast-Metro Boston Regional Office of DEQE (now DEP), Evaluation Criteria for Slurry Wall Trench Cutoff Wall Construction for the Control of Contaminant Migration from a Waste Site. The Massachusetts Field Investigation Team of DEP utilized this guideline for reviewing slurry wall cutoff wall designs for hazardous waste sites and sanitary landfill remedial efforts.

Over the past 15 years Wehran has designed and Mr. Cavalli has constructed many environmental slurry wall systems, including the South Side Landfill (6.2 miles of 100' deep slurry wall) in Indiana, Edgeborough Disposal (4+ miles at 60' deep) in East Brunswick, New Jersey and Hamms Sanitary Landfill (1 mile at 50' deep) in Lafayette, New Jersey, as well as the first environmental slurry wall project at a Superfund Site at Broadhead Creek in Stroudsburg, Pennsylvania. All of these facilities are currently functioning as designed.

Please be reassured that the environmental containment slurry wall system proposed for construction at the RESCO Saugus Landfill is designed to function as intended for many decades.

Sincerely,

WEHRAN ENGINEERING CORPORATION

D. Gary Heathcock
Engineering Project Manager

Nicholas J. Cavalli
Construction Project Manager

DGH/NJC/cje
cc: H. B. Manning, RESCO Plant Manager

ATTACHMENT C

RESCO

100 Salem Turnpike
Saugus, MA 01906
Tel. 617-233-7600
Fax. 617-231-2793

November 29, 1994

Mr. Edward H. MacDonald
Regional Engineer for Waste Prevention
Department of Environmental Protection
10 Commerce Way
Woburn, MA 01901

Dear Mr. MacDonald:

This letter represents Refuse Energy Systems Co.'s (RESCO) response to condition 5 of the Final Engineering Plan (FEP) Approval and Existing Facility Permit issued by the Department of Environmental Protection (Department) on August 9, 1991. Condition 5 of that approval states:

> "5. In the event the Leachate Collection System fails to achieve an intergradient condition within six (6) months of the date of completion of the slurry wall or the expiration of the slurry wall installation period, as defined in paragraph 8.D.(1)(a)(iv) of the Consent Order, whichever is shorter, RESCO shall submit to the Department for approval, within thirty (30) days of such failure, a plan and implementation schedule for achieving an intergadient condition."

The earlier of the referenced dates is the date of the completion of the slurry wall which is considered to be May 27, 1994, the date of the Department's approval of the RESCO Saugus Landfill Construction Certification Report of the Partial Closure Project (Certification Report). Since an intergadient condition at the landfill will not be achieved by November 27, 1994, 6 months after completion, this plan and implementation schedule, due no later than December 27, 1994, is being submitted for your consideration and approval.

This report is intended to inform the Department regarding: RESCO's progress in removing, treating and utilizing leachate from the landfill; the continuing progress towards the goal of achieving an intergadient condition at the landfill; and our projections for the achievement of that goal.

Leachate Containment Removal and Re-Use

The leachate containment removal and re-use system consists of a slurry wall and leachate collection, pumping, conveyance and treatment systems. The slurry wall consists of an impervious soil/bentonite mixture placed in a trench that was excavated from the landfill surface to an average depth of 40 feet, 30± feet below sea level, and keyed into low permeability soils underlying the landfill. Slurry wall technology has been commonly applied for decades to create hydraulic barriers and to isolate ground waters. The rapid buildup of groundwater inside the slurry wall creating a five foot head differential in the landfill is testimony to the effective impermeability of the landfill slurry wall.

The leachate is collected through a 6 inch diameter slotted pipe located below sea elevation within a column of highly permeable sand. It directs leachate flows by gravity to three pump stations located within the landfill. Leachate is pumped through a valve chamber into a common force main and conveyed to the adjacent trash-to-energy facility. Leachate is then treated and/or utilized at the facility with any excess being discharged to the Saugus sewer system in accordance with an industrial wastewater discharge permit.

Leachate removal from the landfill began in the summer of 1993 during the installation of the leachate collection system to assist in the dewatering of the leachate trench during construction. Although collection was sporadic due to the shake down of the pumping and treatment systems, 16.5 million metered gallons of leachate were removed from the landfill in 1993. From January through October, 1994, 44.7 million gallons of leachate have been removed from the landfill for treatment and re-use/discharge (Attachment 1). This represents a daily average of 147,000 gallons, substantially greater than the 111,000 GPD average and greater than the peak monthly flow of 140,000 GPD suggested by the FEP. In summary, we believe that the leachate collection, treatment and re-use systems have functioned optimally and have exceeded expectations in their ability to remove leachate from the landfill environment interior to the slurry wall.

Ground Water Elevations

In late 1993, nine pairs of piezometers designed to measure the relationship between the groundwater elevations inside and outside of the slurry trench were installed. Since January 4, 1994, each piezometer pair has been read on a weekly basis and averaged on a 28 day tidal cycle in accordance with the requirements of the FEP (Attachment 2). Since the approval of the Certification Report, the groundwater elevations have been reported to the Department monthly. A review of that data indicates dramatic progress towards our goal of achieving an intergradient condition. The average elevation of the groundwater inside of the slurry wall has been reduced by four feet.

The average gradient between piezometer couplets has been reduced from 5 ft. to 1.6

ft. Two piezometer couplets demonstrated an intergradient condition on November 1, 1994. An additional 1.7 ft. reduction of the average groundwater elevation inside the slurry all will result in an intergadient condition. A graphical presentation of piezometer elevation readings is included in this report (Attachment 3).

Implementation Plan

It is anticipated that steady progress will continue toward the achievement of an intergradient condition. The rate of reduction of the groundwater elevation interior to the slurry wall will likely moderate during the winter and spring months due to snow melt and spring rains. Nevertheless, we expect to be able to achieve an intergadient condition during the summer of 1995. As more piezometer couplets reach compliance levels, the leachate pumping systems will be adjusted to selectively favor leachate removal from those areas of the landfill facility that have yet to achieve the intergradient standard. Concurrently, our efforts to minimize infiltration into the landfill will continue. To date, approximately 40 acres of final cover have been completed and an additional 100 acres are covered with low permeability intermediate cover material appropriately graded to minimize infiltration. Final and intermediate cover areas have been seeded to enhance evapotranspiration. In 1995, approximately 25 acres of Phase I are scheduled for final cover.

We believe that the best course of action is to continue to optimize leachate removal rates from the landfill while minimizing the potential infiltration. Our consistent performance to date reassures us that the goal of achieving an intergradient condition will be reached in the near future.

We appreciate your continuing attention to these matters and look forward to your review and approval of this plan.

Very truly yours,

H. Bruce Manning
Plant Manager

HBM:lc

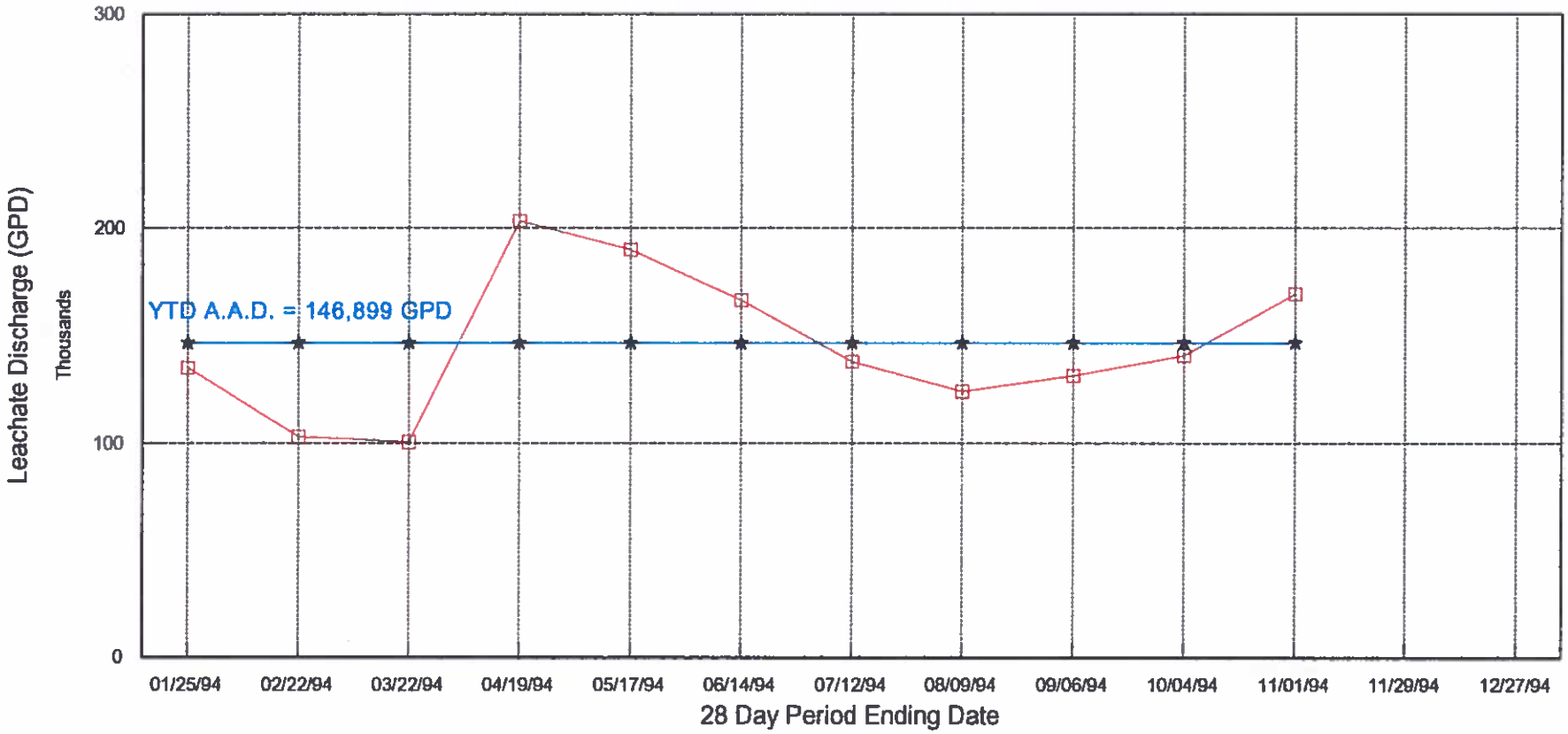
cc: G. Heathcock
R. Jacques
M. Koenigs
T. Mahin
S. Richmond

/five

ATTACHMENT 1

RESCO - Saugus Landfill

Landfill Leachate Discharge



By: M. Koenigs
Date: 11/15/94

ATTACHMENT 2

RESCO - Saugus Landfill

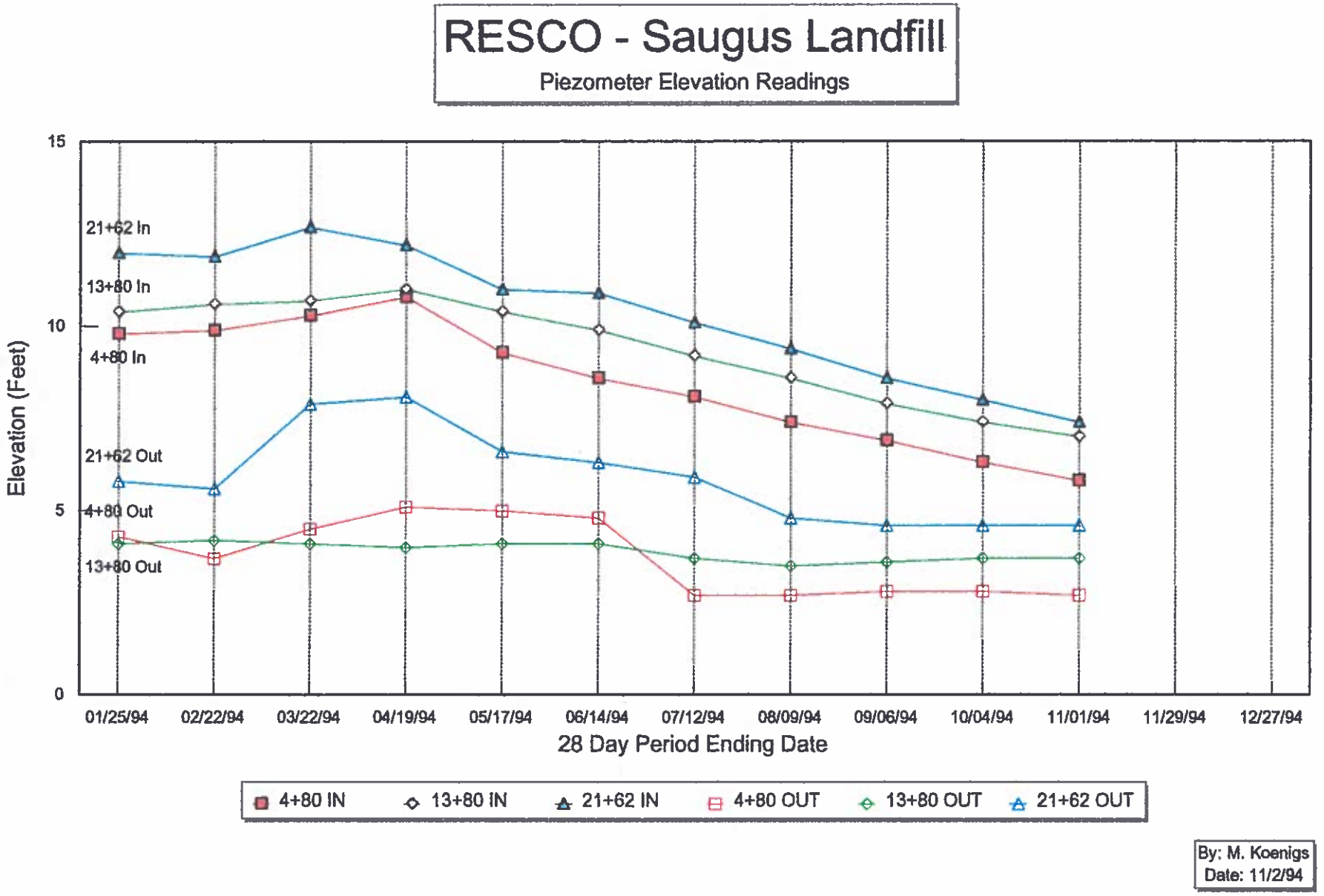
Piezometer Groundwater Elevation Readings
Progress Report - 1994

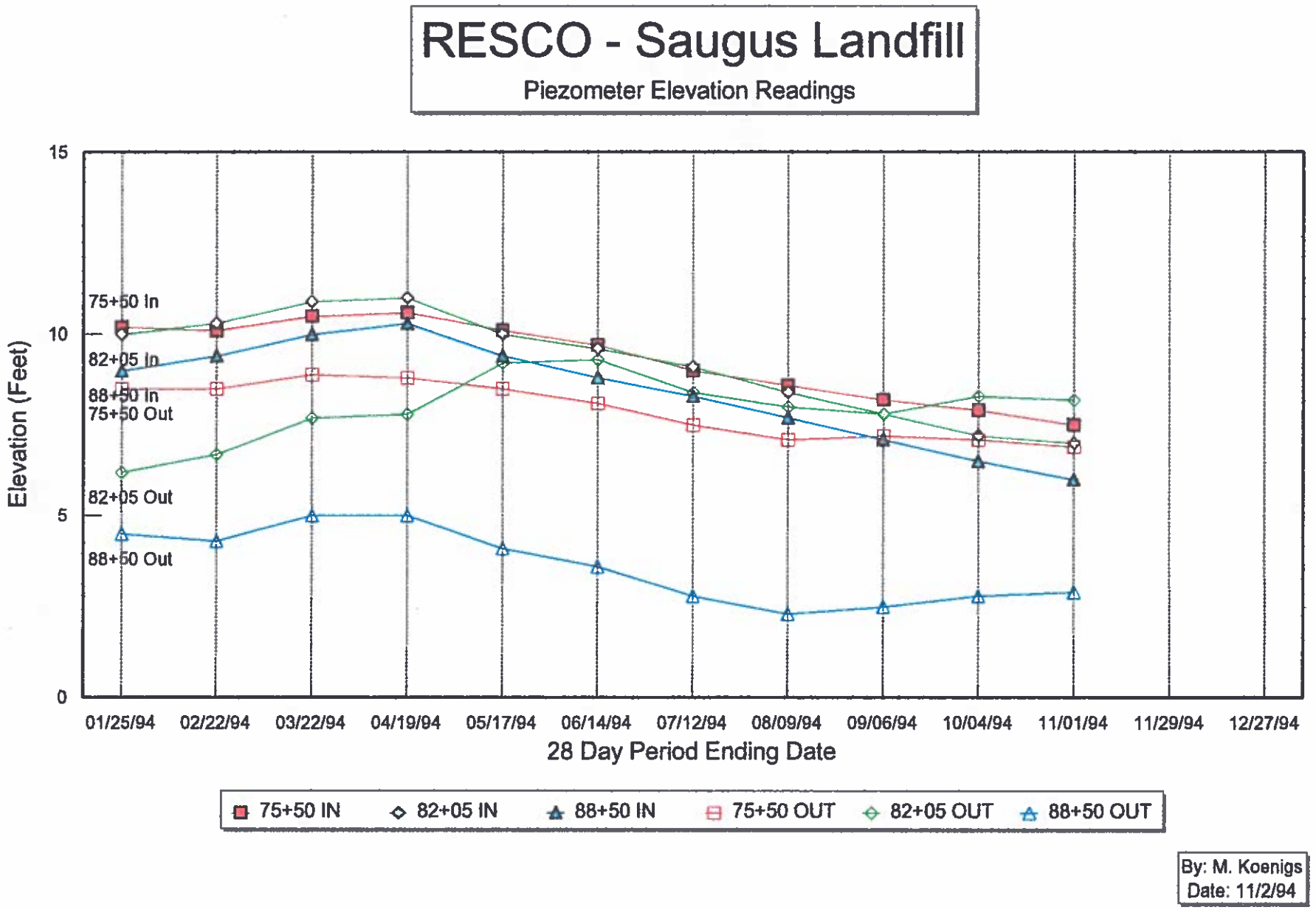
Date: 11/2/94
By: M. Koenigs

Date	01/25/94	02/22/94	03/22/94	04/19/94	05/17/94	06/14/94	07/12/94	08/09/94	09/06/94	10/04/94	11/01/94	11/29/94	12/27/94
Period	Test 1	Test 2	Test 3	Test 4	Test 5	1	2	3	4	5	6	7	8
	Start-up and Trial Period Testing of System					(5)							
Locations	28 Day Average - Elevation Readings in Feet												
4+80 In	9.8	9.9	10.3	10.8	9.3	8.6	8.1	7.4	6.9	6.3	5.8		
4+80 Out	4.3	3.7	4.5	5.1	5.0	4.8	2.7	2.7	2.8	2.8	2.7		
13+80 In	10.4	10.6	10.7	11.0	10.4	9.9	9.2	8.6	7.9	7.4	7.0		
13+80 Out	4.1	4.2	4.1	4.0	4.1	4.1	3.7	3.5	3.6	3.7	3.7		
21+62 In	12.0	11.9	12.7	12.2	11.0	10.9	10.1	9.4	8.6	8.0	7.4		
21+62 Out	5.8	5.6	7.9	8.1	6.6	6.3	5.9	4.8	4.6	4.6	4.6		
39+80 In	13.2	12.8	13.2	12.5	11.5	11.0	10.1	9.4	8.8	8.2	7.6		
39+80 Out	6.2	6.4	6.7	6.5	6.5	6.4	6.0	5.5	5.9	6.2	5.7		
49+50 In	12.3	12.1	12.7	12.4	11.0	10.5	9.6	8.8	8.2	7.7	7.1		
49+50 Out	6.4	6.6	6.9	6.6	6.9	6.7	6.1	5.7	6.4	6.7	6.6		
59+25 In	11.0	10.9	11.3	11.3	10.3	9.9	9.2	8.5	7.9	7.3	6.8		
59+25 Out	6.6	7.2	8.1	8.4	7.1	7.3	6.4	5.8	6.4	7.0	6.9		
75+50 In	10.2	10.1	10.5	10.6	10.1	9.7	9.0	8.6	8.2	7.9	7.5		
75+50 Out	8.5	8.5	8.9	8.8	8.5	8.1	7.5	7.1	7.2	7.1	6.9		
82+05 In	10.0	10.3	10.9	11.0	10.0	9.6	9.1	8.4	7.8	7.2	7.0		
82+05 Out	6.2	6.7	7.7	7.8	9.2	9.3	8.4	8.0	7.8	8.3	8.2		
88+50 In	9.0	9.4	10.0	10.3	9.4	8.8	8.3	7.7	7.1	6.5	6.0		
88+50 Out	4.5	4.3	5.0	5.0	4.1	3.6	2.8	2.3	2.5	2.8	2.9		

Notes:

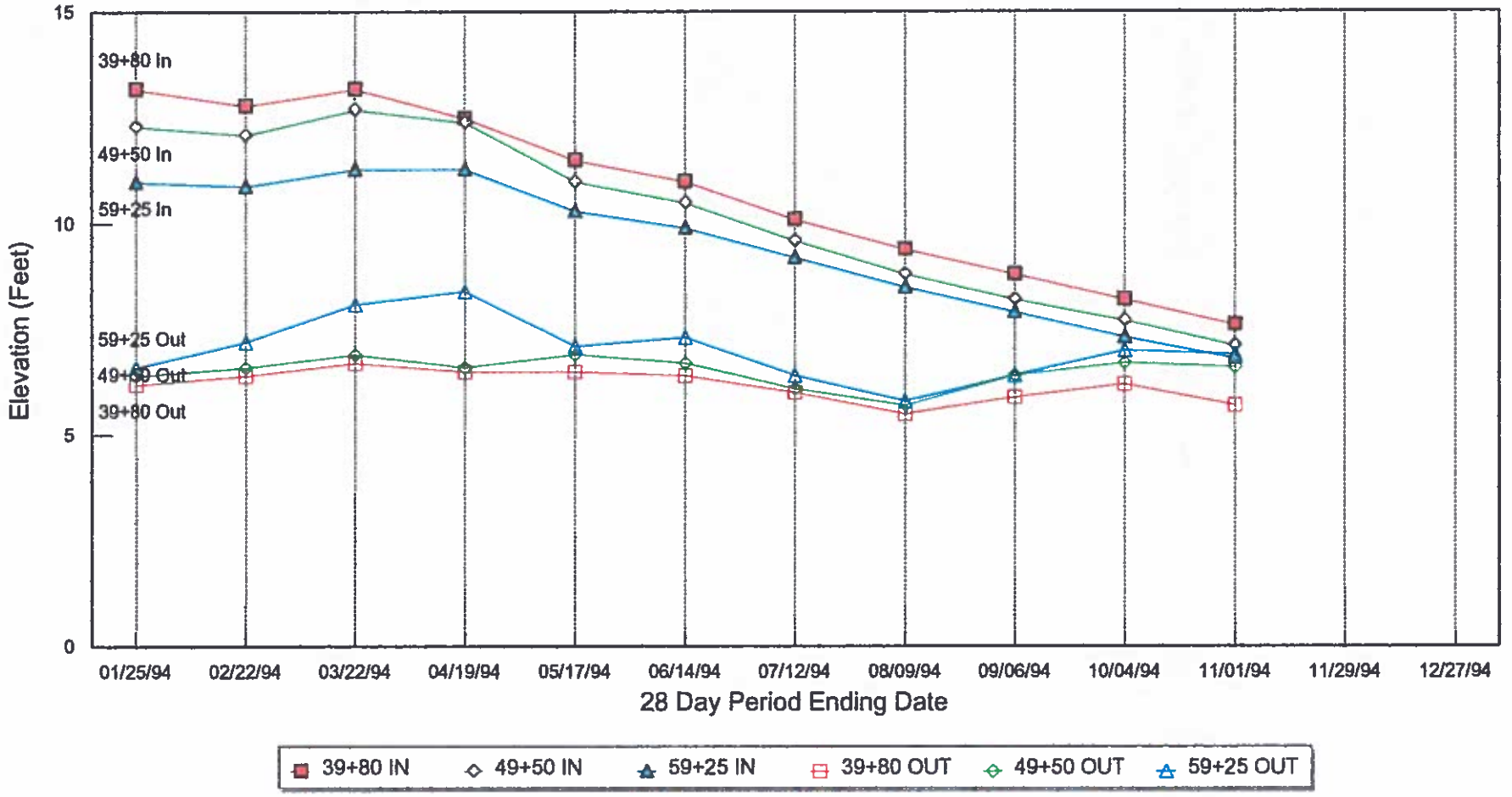
1. All elevations refer to N.G.V.D. 1929.
2. Piezometers were last referenced calibrated on 12/16/93 and redeveloped on 4/21/94.
3. Locations of piezometers refer to slurry wall stationing shown on the FEP drawings, sheet 2 of 20.
4. Readings are based on a monthly (four week) average, per the FEP procedure discribed in Section 6.
5. First required monitoring period following approval of the Partial Closure Construction Certification Report.


RESCO - Saugus Landfill
Piezometer Elevation Readings
Elevation (Feet)
15
10
5
0
21+62 In
13+80 In
4+80 In
21+62 Out
4+80 Out
13+80 Out
01/25/94
02/22/94
03/22/94
04/19/94
05/17/94
06/14/94
07/12/94
08/09/94
09/06/94
10/04/94
11/01/94
11/29/94
12/27/94
28 Day Period Ending Date
4+80 IN
13+80 IN
21+62 IN
4+80 OUT
13+80 OUT
21+62 OUT
By: M. Koenigs
Date: 11/2/94


RESCO - Saugus Landfill
Piezometer Elevation Readings
Elevation (Feet)
15
10
5
0
75+50 In
82+05 In
88+50 In
75+50 Out
82+05 Out
88+50 Out
01/25/94
02/22/94
03/22/94
04/19/94
05/17/94
06/14/94
07/12/94
08/09/94
09/06/94
10/04/94
11/01/94
11/29/94
12/27/94
28 Day Period Ending Date
75+50 IN
82+05 IN
88+50 IN
75+50 OUT
82+05 OUT
88+50 OUT
By: M. Koenigs
Date: 11/2/94

RESCO - Saugus Landfill

Piezometer Elevation Readings



By: M. Koenigs
Date: 11/2/94